orders in response to attractive offers of hundred-pound prizes the expectation value of which is not one-tenth of the price paid. Yet it was only recently that the Central Welsh Board excluded probabilities from an examination syllabus in algebra which was simply loaded up with questions on collections of letters and symbols that could convey no meaning to the victims of the examination system.

Other applications are to such problems as life assurance and statistics. In the former the calculations must, of course, be largely left to experts, but the public ought to acquire an intimate familiarity with the nature and meaning of probability and expectation and their numerical representation in order properly to appreciate the transactions. This elementary knowledge should come under arithmetic, not algebra. As for statistical applications, the systematic way in which parliamentary electors are misled for lack of understanding these things is evident. They have not realised that when wages go up prices also go up.

Now Prof. Castelnuovo's treatise strikes the reviewer as just the kind of book of which it would be worth while to publish an English translation. It is a long time since we had a standard work on the subject on similar lines, and in the interval our notions on teaching mathematics have certainly moved in a practical direction. Prof. Castelnuovo's book well meets the situation. Of course, the treatment is mathematical and the calculus is freely used, but the formulæ are introduced as statements of principles rather than as purely algebraic relations, and the whole treatment centres largely round practical applications. Any B.Sc. candidate would find the book quite easy reading, and the subject very useful in connection with physics, biology, philosophy, or, indeed, any branch of science, even including that all-embracing subject, aeronautics. A special feature on the more advanced side is the account given at the end of the discoveries of Tchebychef, who is quoted as having made the greatest contributions to the subject after Laplace.

Of course, the initial difficulty lies in the definition of probability, regarding which Prof. Castelnuovo's treatment both in the preface and at the beginning of the text is probably as good as the circumstances permit. There is no unique definition of probability, and in most cases no unique measure of its value. The old definition by an event which may happen in *m* ways and fail in *n* ways postulates a preconceived condition of "equal probability" for the *m* and *n* ways. There are, as Prof. Castelnuovo points out, many cases, in particular in games of chance, in which this postulate is admissible and the measure of probability has something like a unique value. But in most cases the estimated probability of an event depends on the extent of knowledge possessed by the person making the estimate, and, indeed, is a continually varying quantity depending on the progress of previous events. No two people would assign the same measure to the probability of a certain candidate passing an examination, and, indeed, the estimated chance varies continuously until the appearance of the list (sometimes even afterwards!). All that we can do in place of a definition is to substitute numerous examples in which the measure of probability is free from ambiguity. The nearest approach to a definition is given by the rules for compounding probabilities, of which the above-mentioned old definition is a particular case, with the additional convention that the probability always lies between 0 and 1, and that after an event has happened we must substitute 1 for the probability of its happening and 0 for the probability of its failing in our future estimates of the probabilities of dependent events. In fact, the theory of probability owes its existence to ignorance of future, and partial ignorance of past, events.

Attention has been frequently directed by the reviewer to energy running to waste among our mathematicians which could be utilised in connection with aeroplanes. In our universities a great deal of waste energy in the departments of pure mathematics could also be utilised by turning out graduates with a knowledge of probabilities and statistics which would filter down through the teachers to the elementary schools and thus to the citizens of the future. And for a start at the top of the ladder, Prof. Castelnuovo's book seems excellent.

G. H. BRYAN.

THE STUDY OF THE FAMILIAR.

A Source Book of Biological Nature-Study. By Elliot Rowland Downing. (The University of Chicago Nature-Study Series.) Pp. xxi + 503. (Chicago, Illinois: The University of Chicago Press; London: The Cambridge University Press, 1919.) Price 3 dollars net.

IT is encouraging to read that never before has there been in America "so insistent a demand for a more thorough and more comprehensive system of instruction in practical science." To direct this demand, Mr. Downing is editing a Nature-study series, and has written a source book for the biological side. It aims at showing students in schools of education and teachers at work what materials are readily available and

© 1920 Nature Publishing Group

how these may be effectively used. "It undertakes to make significant some of the commonplace environment and to suggest ways in which living material may serve educational ends." Great prominence is given to material which has social and practical interest, but the danger of fostering a one-sided utilitarian outlook is guarded against. "The great contributions of science to the life of mankind are: its emphasis on the scientific mode of thinking or the problem-seeing, problem-solving attitude of mind; a mass of scientific knowledge that serves as the basis for desirable skills; and an interpretation of Nature productive of an inspiring appreciation, both intellectual and æsthetic, of her phenomena. Science instruction needs to assure these things to the individual pupil." These are clearly defined aims, and the book appears to us to be highly successful in all the three directions indicated—in setting problems and cultivating the curious spirit; in showing that Nature-study makes for efficiency as well as for understanding; and in cultivating a reasonable love of Nature. A note with fine resonance is struck when the author declares his ambition to treat his material so that "the everyday things may stand revealed as the wonders they really are."

The book deals with animals of pond and stream, insects and their allies, birds, gregarious animals, wayside flowers, common trees, seeds and seedlings, the garden, and spore-bearing plants. Each chapter has its list of references; there are practical hints as to material; the illustrations are abundant and interesting. They include some pupils' drawings. There is a genuine attempt throughout to get at the child's point of view and to use its judgment of values. "The teacher needs to take much of the foolishness of childhood along with her, and needs also to be persuaded that it is not altogether foolish." But there is no namby-pamby nonsense. We wonder a little, however, at some of the phrases which are unfamiliar to us, such as the chick's egg or the chicken's egg. Why not the hen's egg, and be done with it?

Of the many features which are admirable, we may give a few illustrations: (*a*) There is an embarrassment of living creatures in many country places. The author's plan is to make sure of the commonest—let us say, a score of the butterflies, birds, or trees. (*b*) There are many subjects which are so little understood that the cautious teacher is often inclined to leave them alone. The author's advice is rather to tackle them, to confess them as unsolved problems, and to leave them as seeds in the mind. We refer to such subjects as the migration of birds. (*c*) The author is not afraid of sounding the note of wonder. "To watch the germination of an inert seed, the development therefrom of the tiny plant, the growth of bursting bud and flower, is to cross the threshold of Nature's impenetrable mysteries." He quotes the sentence: "The love of a flower in the heart of a child is the highest thing that Nature-study can hope to develop." But the suggestion of this mood is not inconsistent with learning quite precisely how to graft or with understanding the work of Mendel or of Pasteur. We are sure that teachers of Nature-study will find Mr. Downing's book very profitable, and they ought also to know his almost perfect introduction to heredity, "The Third and Fourth Generation."

VACCINE-THERAPY.

Practical Vaccine Treatment for the General Practitioner. By Dr. R. W. Allen. Pp. xii + 308. (London: H. K. Lewis and Co., Ltd., 1919.) Price 7*s*. 6*d*. net.

THE author of this little work is well known as an enthusiastic advocate of vaccine-therapy, on which subject he has already written widely. In the present volume he addresses himself more particularly to the general practitioner, for whose benefit and guidance he explains in lucid and forcible terms his methods and practice. The one theme which runs through the whole volume, and colours his frequent comments on the experience and teaching of other vaccinists, is his insistence on the necessity for adequate dosage capable of exciting focal or general reactions and its control by the closest observation of the patient's responses and clinical symptoms. He asks his readers to follow his methods and thereby assist vaccine-therapy "to take its rightful position as the most truly scientific therapeutic agent in the doctor's armamentarium." Unfortunately, however, the book contains scarcely one pessimistic note, and, again, the unbiassed reader, who otherwise wishes vaccine-therapy well, is left with the reflection that, so long as the results of vaccine-therapy continue to be assessed by the unscientifically accumulated personal impressions of vaccinists, so long will vaccine-therapy continue to hold no higher position than that of an empirical remedy, in spite of its undoubted scientific basis.

On this point the author, referring to vaccine treatment in respiratory diseases, remarks: "No physician has the right to play about with cases of pneumonia to satisfy statisticians or opponents of vaccine treatment. It thus becomes necessary to rely on the clinical impressions of reliable observers." Such impressions, we believe, carry less and less weight when we come to evaluate

© 1920 Nature Publishing Group